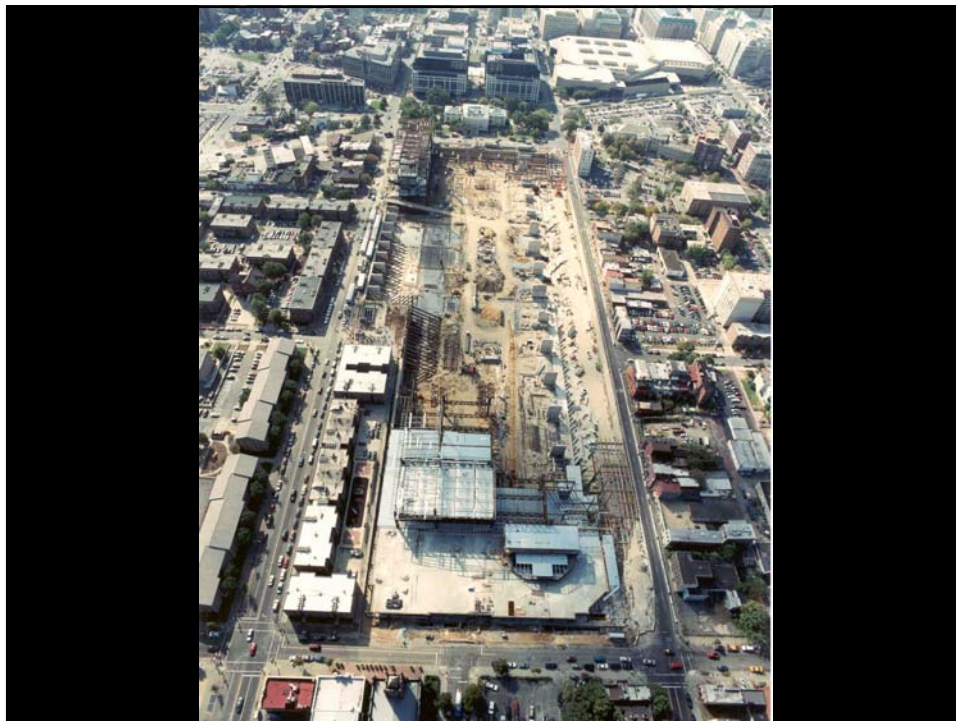


# Planning the BIM Execution Process

**John I. Messner, Ph.D.**

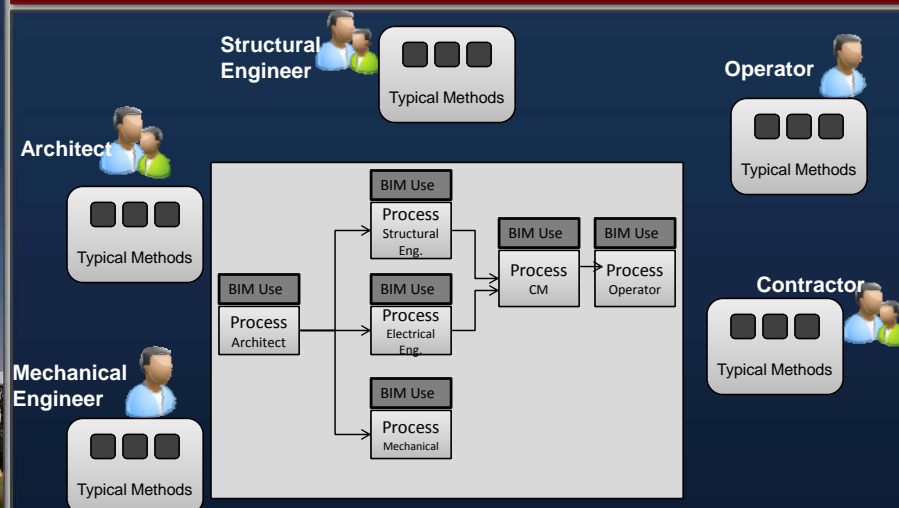
Associate Professor of Architectural Engineering  
Director, Computer Integrated Construction Research Program  
The Pennsylvania State University



## The Challenge

Develop a BIM project execution plan for a project which defines the appropriate uses for BIM on a project and the information exchanges between the various uses.

## BIM Project Execution Planning Process



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## Project Execution Planning for Building Information Modeling



A buildingSMART Alliance project sponsored by:

- The Charles Pankow Foundation
- Construction Industry Institute (CII)
- Penn State Office of Physical Plant (OPP)
- PACE



## Project Goal

Develop a guide that will focus on the decisions required to implement Building Information Modeling throughout the stages of a building project:

- Planning
- Design
- Construction
- Operations

## Project Deliverables

- **BIM Execution Planning Guide**  
Includes decision matrix and guidelines for BIM implementation at various project phases.
- **BIM Execution Planning Application**  
Easy to use application for guiding a team through the decisions required for BIM implementation.

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## Project Overview

- Identify BIM methods and implementation strategies organized by project phase
  - Planning, Design, Construction, Operations
- Develop implementation guidelines and best practice methods
- Disseminate the results
  - BIM Execution Planning Guide
  - Interactive execution planning computer tool
  - Presentations at national conferences e.g. buildingSMART, AIA, AGC BIMForum, etc.
  - Articles in industry and academic publications

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## Team Members

### •Board of Advisory

- Deke Smith – Executive Director of buildingSMART Alliance (Industry Champion)
- Victor Sanvido – Ph.D., Senior Vice President, Southland Industries
- Francois Grobler – Ph.D., US Army CERL and IAI - North America
- Steve Hagan – Project Knowledge Center, U.S. General Services Administration
- Soad Kousheshi – President, AEC Strategy
- Ed Gannon – Manager of Design Services, Penn State Office of Physical Plant
- Mark Falzarano – Barton Malow Company
- Mark Butler – HDR
- Derek Cunz – Director of Project Development, Mortenson Construction
- Mark Konchar- Vice President – Balfour Beatty Construction

### • CIC Research Program Team Members

- John Messner – Director of the CIC Research Program
- Chimay Anumba – Professor and Head of Architectural Engineering
- Sam Hunter – Assist. Professor of Psychology
- Craig Dubler – PhD Student, Architectural Engineering (Construction)
- Colleen Kasprzak – MS Student, Architectural Engineering (Operations)
- Chitwan Saluja – MS Student, Architectural Engineering (Planning)
- Nevena Zikic – MS Student, Architectural Engineering (Design)
- Shane Goodman – BAE/MAE Student, Architectural Engineering

### • Sponsor Representatives


- Bob Tener – Director, The Charles Pankow Foundation
- Steve Thomas – Director of Research, The Construction Industry Institute

	Design Communication	System Analysis	Estimation	Scheduling
Plan	<ul style="list-style-type: none"> <li>▪ Existing Conditions Modeling</li> <li>▪ Programming</li> </ul>	<ul style="list-style-type: none"> <li>▪ Site Selection</li> </ul>	<ul style="list-style-type: none"> <li>▪ Preliminary Cost Estimation</li> </ul>	<ul style="list-style-type: none"> <li>▪ Phase Planning</li> </ul>
Design	<ul style="list-style-type: none"> <li>▪ Design Authoring</li> <li>▪ Design Reviews (Constructability, 3D Design Coordination, Virtual Mock-ups)</li> </ul>	<ul style="list-style-type: none"> <li>▪ Site Analysis</li> <li>▪ Engineering Analysis (Structural, Energy, Lighting, CFD, IAQ Evaluation, Thermal Performance)</li> <li>▪ Code Validation (Emergency Evacuation, Security Analysis)</li> <li>▪ LEED Evaluation</li> </ul>	<ul style="list-style-type: none"> <li>▪ Cost Estimation</li> </ul>	<ul style="list-style-type: none"> <li>▪ Phase Planning (Tenant Fit-out)</li> </ul>
Construct	<ul style="list-style-type: none"> <li>▪ 3D MEP Coordination</li> <li>▪ Digital Fabrication</li> <li>▪ 3D Control and Planning</li> </ul>	<ul style="list-style-type: none"> <li>▪ 3D System Design</li> </ul>	<ul style="list-style-type: none"> <li>▪ Unit Price Estimating</li> </ul>	<ul style="list-style-type: none"> <li>▪ 4D Planning</li> <li>▪ Site Utilization Planning</li> </ul>
Operate	<ul style="list-style-type: none"> <li>▪ Record Model</li> <li>▪ Asset Management</li> <li>▪ Space Management/Tracking</li> <li>▪ Disaster/Emergency Planning</li> </ul>	<ul style="list-style-type: none"> <li>▪ Building Performance Analysis</li> </ul>	<ul style="list-style-type: none"> <li>▪ Maintenance Cost Estimation</li> </ul>	<ul style="list-style-type: none"> <li>▪ Building Maintenance</li> <li>▪ Renovation Coordination</li> </ul>

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## BIM USE from WIKI

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### Virtual Mock-ups

page

discussion (4)

history

notify me

**Goal: Virtual Mock-ups**

Status of Use Document: Early Draft

**Phase(s): Design**

**Objective:**

- ☐ Preview space aesthetics and layout during design review in a virtual environment
- ☐ Able to evaluate effectiveness of design in meeting building program criteria and owner's needs
- ☐ Creates efficiencies in design process
- ☐ Communicate design to client and construction team
- ☐ Eliminate costly onsite mock-ups
- ☐ Reduce time needed to construct mock-up
- ☐ Use virtual mock-up as marketing tool

**Description:**

Mock-ups are used to convey the design to all parties involved and evaluate criteria that is important for that space, e.g. lighting conditions, safety, security, acoustics, sight lines, aesthetics, ergonomics, etc. Traditionally, mock-ups are full-scale representations of the space constructed out of plywood or full finish materials for a realistic representation of the design. Traditional mock-ups are inherently expensive and time consuming to construct. Virtual mock-ups can replace traditional mock-ups to finalize design issues, minimizing time and money.

**Potential Benefits:**

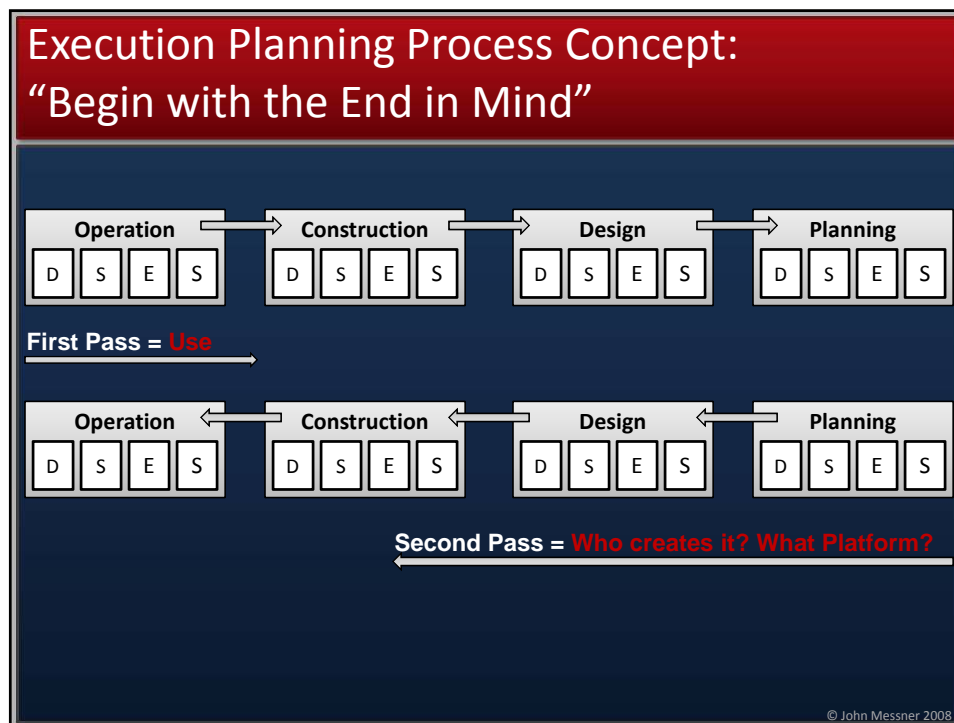
- ☐ Reduce time and money (possibly 1/5 the cost of a traditional mock-up) needed to construct mock-up (1)
- ☐ Able to model different design alternatives or scenarios
- ☐ Real-time modification of model during review by project participants
- ☐ Virtual mock-ups are an effective means of communication among team members
- ☐ Shorter review time of model by project participants

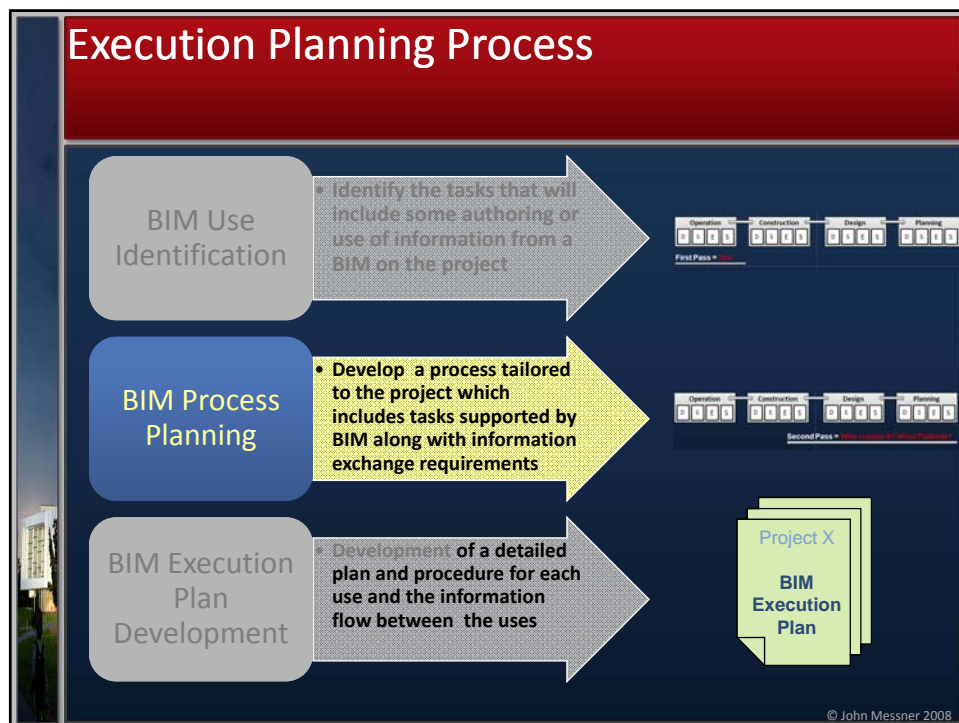
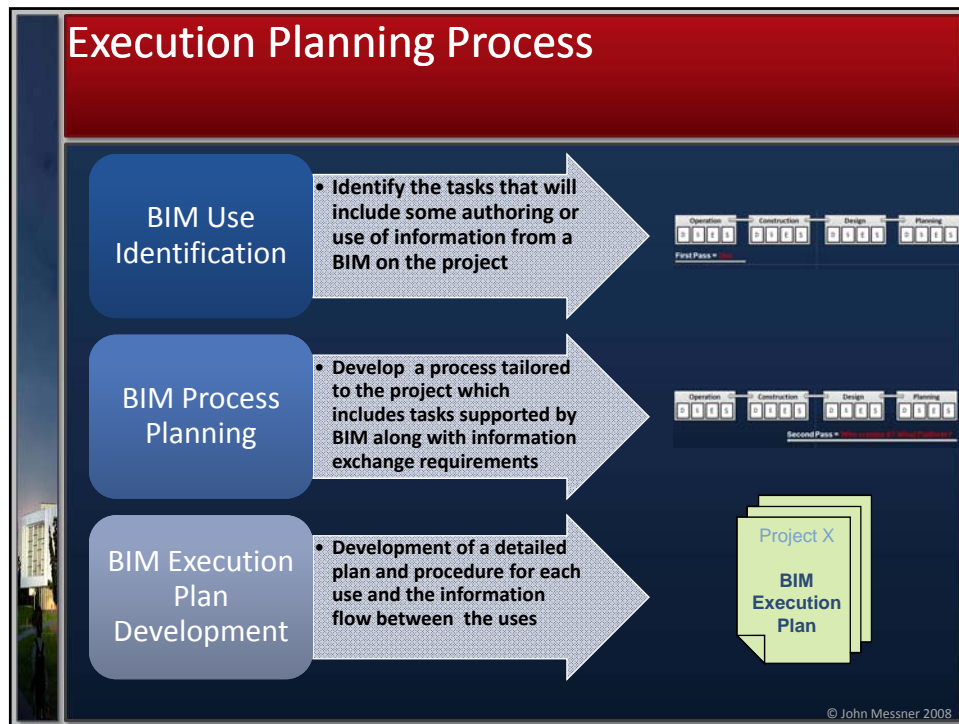
**Levels of Detail Considerations:**

- Depends on what purpose of mockup is
  - Less detailed for space issues
  - More detailed for finish issues
- Highest possible detail best for construction where you need to view finishes and textures

**Team Competencies Required:**

- Need training course to teach designers how to model in 3D and use virtual mock-ups
- Should be company wide
- Typically not a generational gap between young and old







## Execution Planning Categories

Project Reference Information	<ul style="list-style-type: none"> <li>• Critical project overview information, contractual requirements related to BIM, and key project contacts</li> </ul>
Project Goals / BIM Objectives	<ul style="list-style-type: none"> <li>• Document the underlying purpose for BIM implementation on the project and why key BIM use decisions were made</li> </ul>
BIM Process Design	<ul style="list-style-type: none"> <li>• Develop process maps for project activities related to BIM</li> <li>• Define information exchanges</li> </ul>
Delivery Strategy / Contract	<ul style="list-style-type: none"> <li>• Definition of the delivery structure, selection, and contracting</li> </ul>
BIM Scope Definitions	<ul style="list-style-type: none"> <li>• Include model elements by discipline, level of detail, and specific attributes</li> </ul>
Organizational Roles and Responsibilities	<ul style="list-style-type: none"> <li>• Define the roles of each organization along with responsibilities</li> <li>• Define contracting strategies for organizations</li> </ul>
Communication Procedures	<ul style="list-style-type: none"> <li>• Electronic communication procedures</li> <li>• Meeting communication procedures</li> </ul>
Technology Infrastructure Needs	<ul style="list-style-type: none"> <li>• Hardware, software, space, and networking requirements</li> </ul>
Model Quality Control Procedures	<ul style="list-style-type: none"> <li>• Identify the methods to ensure model accuracy and comprehensiveness</li> </ul>

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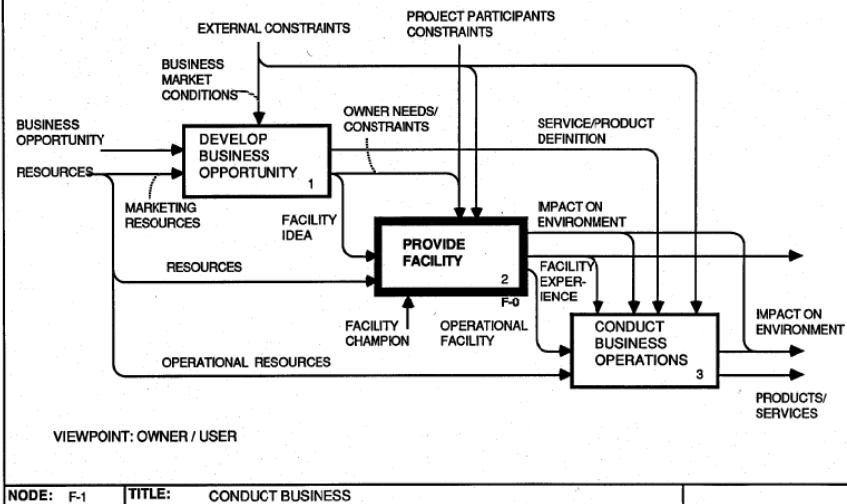
## Making an Argument for a Project Specific Process Plan for BIM Implementation



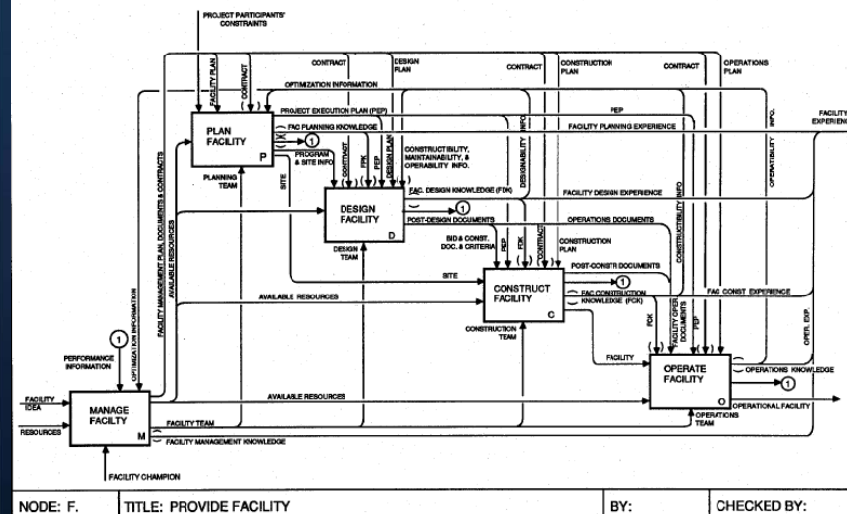
### Premise 1

Generic process models (maps) for the facility delivery process can be developed to aid in the project planning process for BIM.

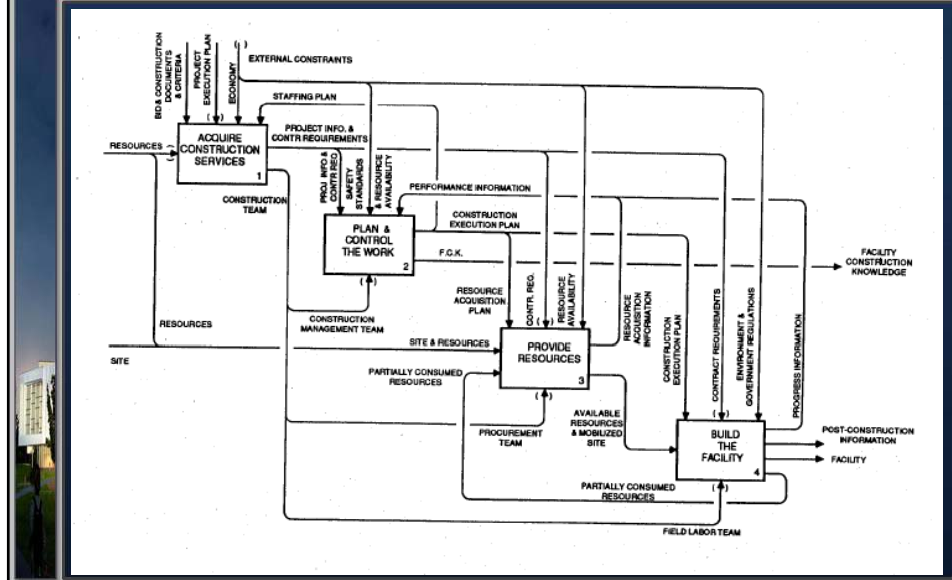
## Integrated Building Process Model (IBPM)



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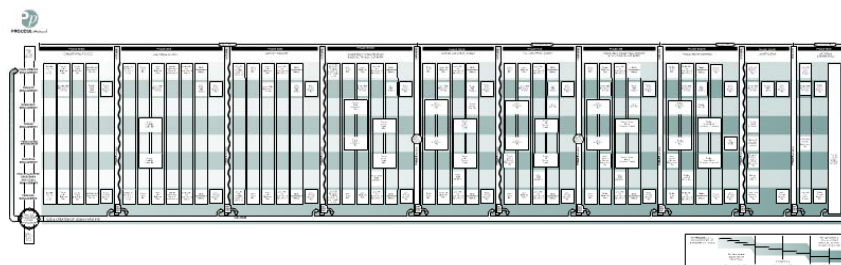


## Example Process: Construct Facility



## Process Protocol

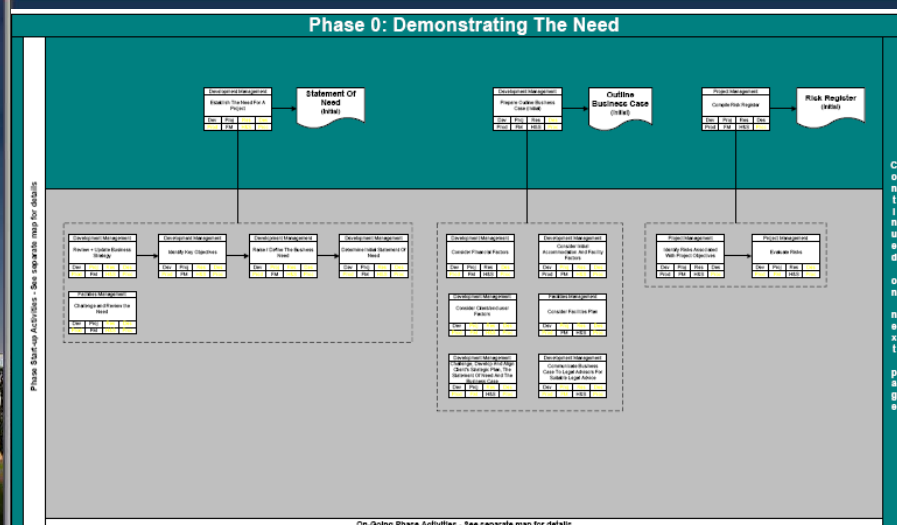
Includes 10 phases of the project lifecycle, the main participants enacting the process, the deliverables of the process and the way in which the process is managed through the phase review process.

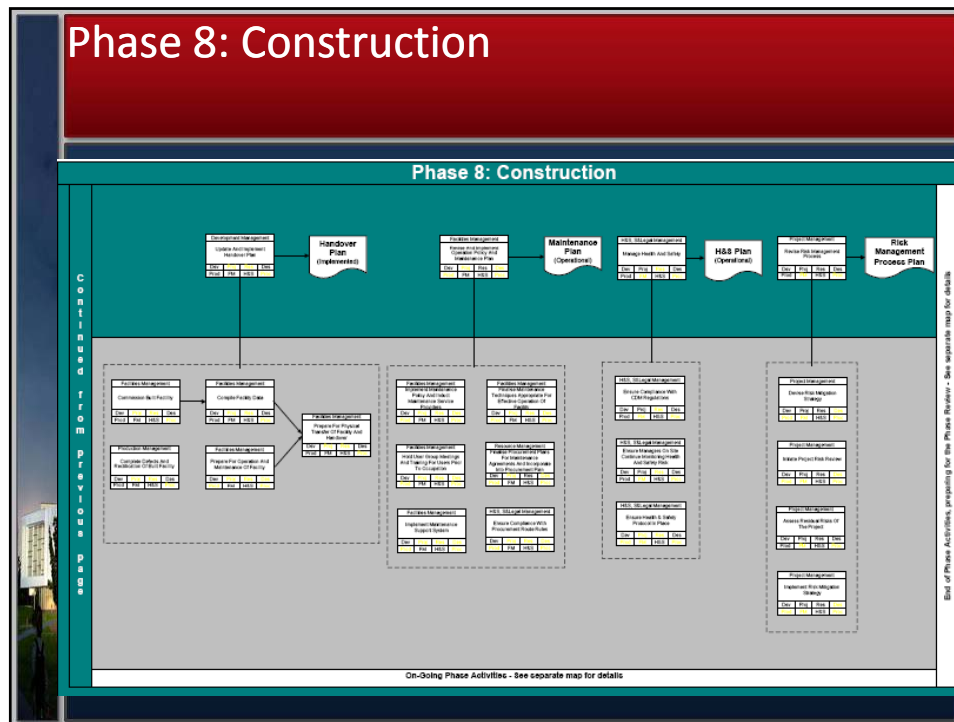


## Process Protocol Phases

- Portfolio requirements
- Conception of Need
- Outline Feasibility
- Substantive Feasibility
- Outline conceptual design
- Full conceptual design
- Coordinated design (and procurement)
- Production Information
- Construction
- Operation and maintenance
- Disposal

## Phase 0: Demonstrating the need



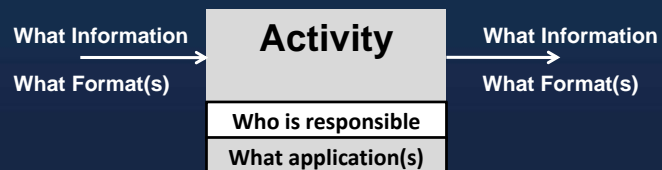


We need to continue to build the generic process maps to support the level of detail needed for BIM project execution planning.

## Premise 2

Project teams can create a **project specific process map** which defines the activities and information exchanges for their project.

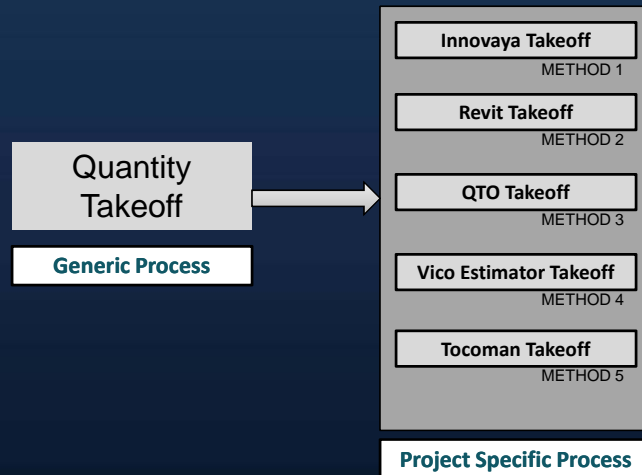
## Planning the Information Requirements for an Activity





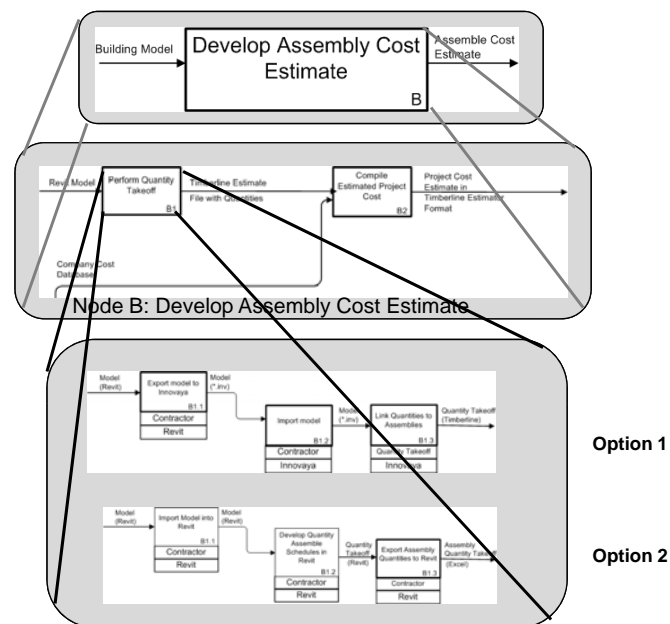
## Process Planning Concept Example

*From Generic To Project Specific*



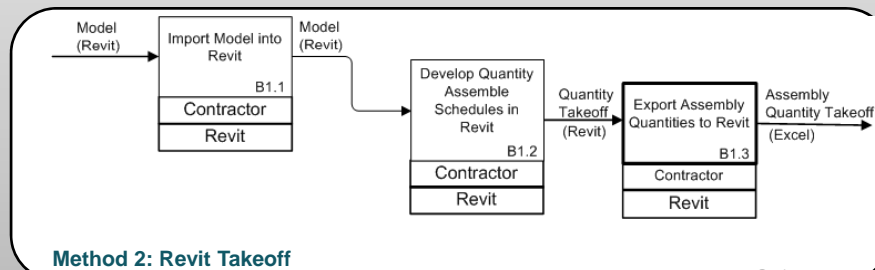
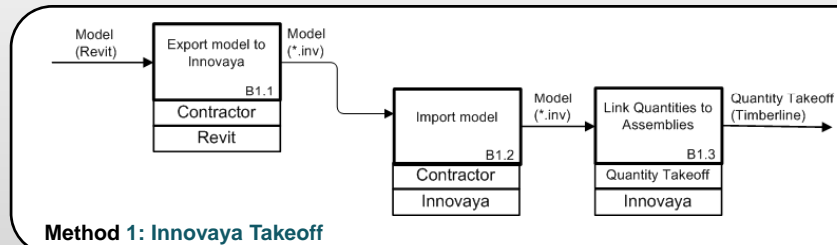
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## Process Planning Concept



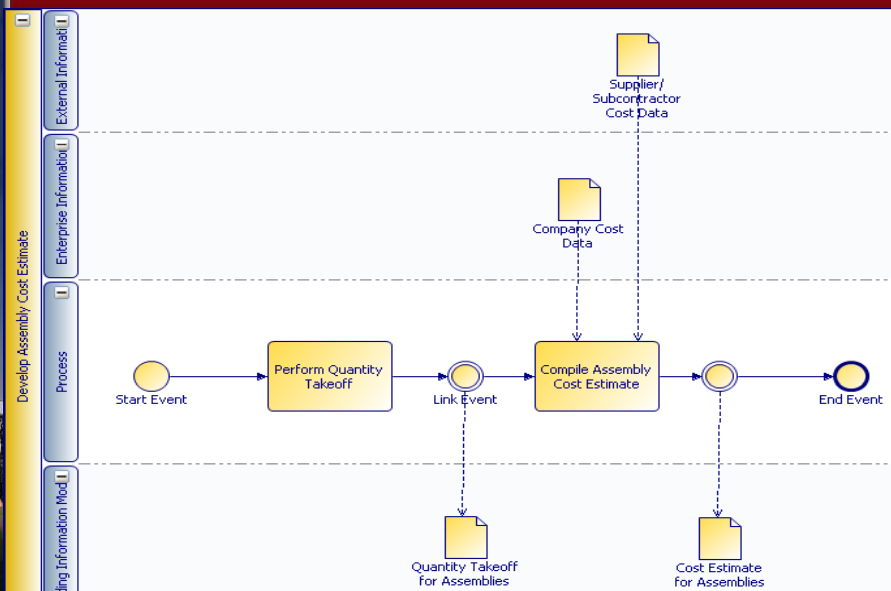
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## BIM Use Example: From Generic to Specific Method



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

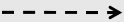

## BIM Use Example: Develop Assembly Cost Estimate



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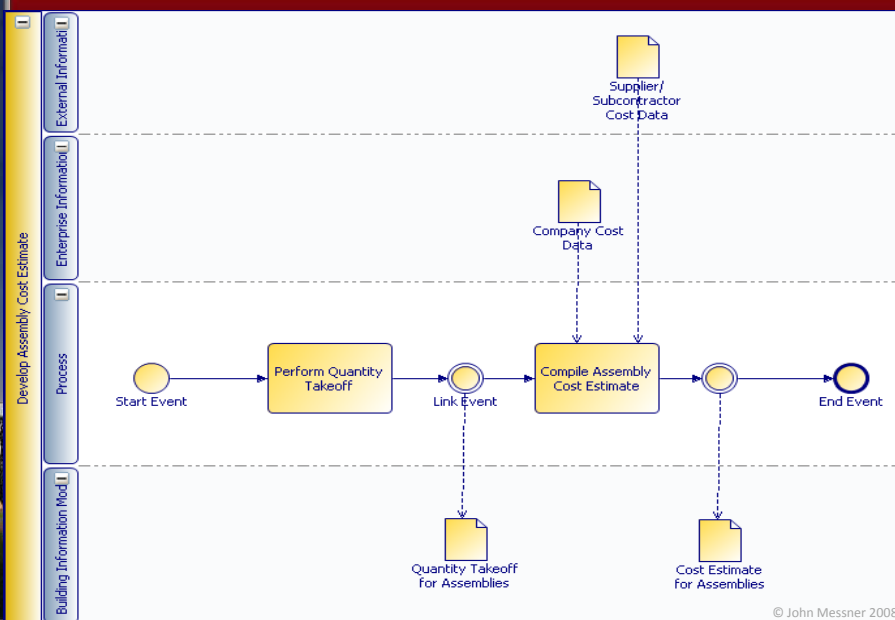
# Business Process Modeling Notation (BPMN)

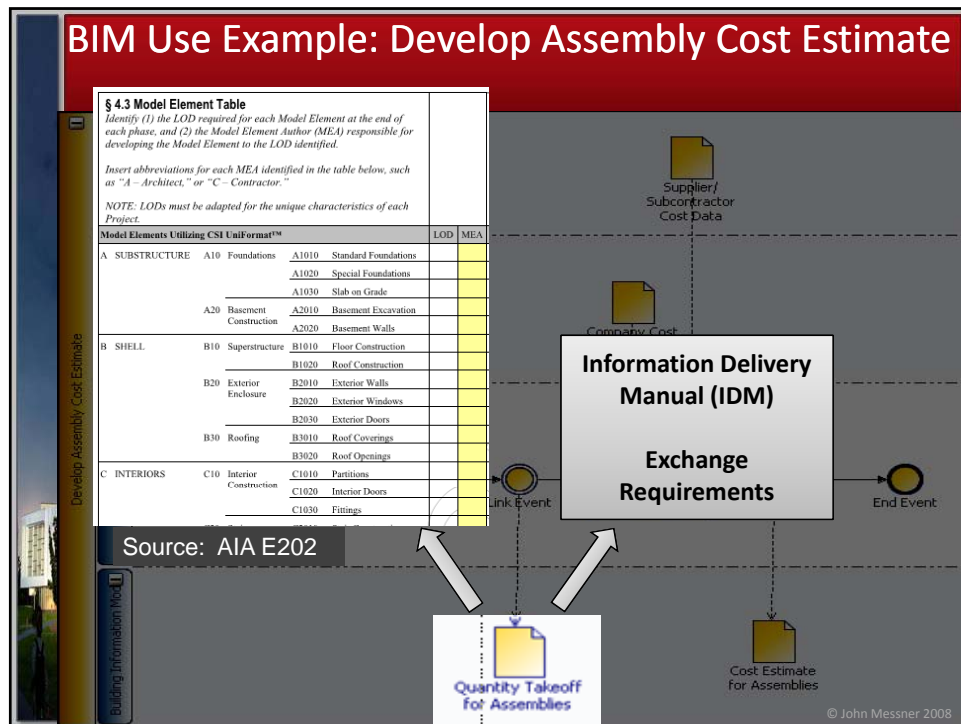
BPMN is a graphical representation for specifying business processes in a workflow.

Element	Description	Notation
<b>Event</b>	There are three types of Events, based on when they affect the flow: Start, Intermediate, and End.	
<b>Activity</b>	An activity is a generic term for work that company performs	
<b>Sequence Flow</b>	A Sequence Flow is used to show the order that activities will be performed in a Process	
<b>Association</b>	An Association is used to associate information with Flow Objects.	
<b>Data Object</b>	Data Objects are considered Artifacts because they do not have any direct effect on the Sequence Flow or Message Flow of the Process, but they do provide information about what activities require to be performed and/or what they produce	

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## BIM Use Example: Develop Assembly Cost Estimate

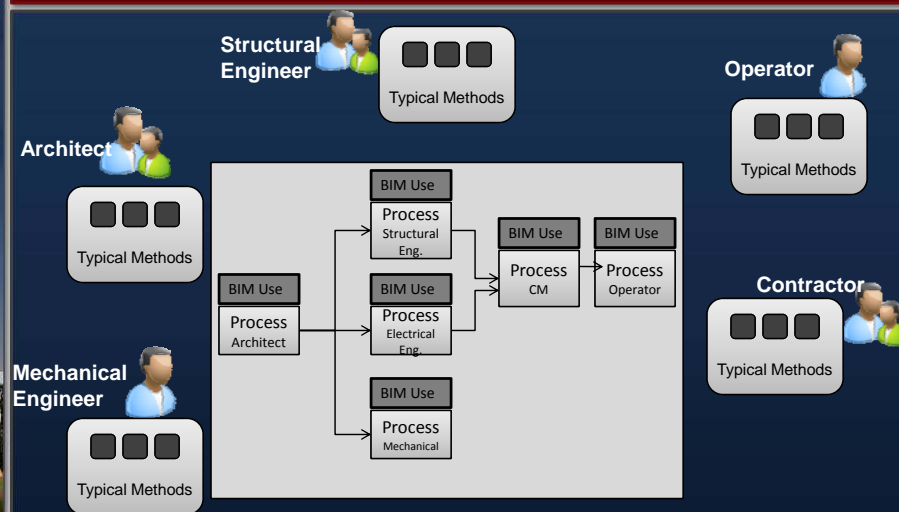




## Premise 3

Enterprises can develop template process maps for activities that they perform within the delivery process.

## BIM Project Execution Planning Process



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## Conclusions

*If:*

- We start with a generic process map of the delivery process with potential activities which use BIM
- We develop a project specific map from enterprise template maps

*Then:*

- We can develop a well designed project process model for BIM implementation and gain the benefits of the planning process:
  - Dependable workflow
  - Well defined information exchanges
  - Better communication of requirement
  - Predictable outcome

## Acknowledgements

- buildingSMART Alliance Project Sponsors
  - The Charles Pankow Foundation
  - The Construction Industry Institute (CII)
  - Penn State Office of Physical Plant
  - Partnership for Achieving Construction Excellence (PACE)
- BIM Execution Planning Team
  - Advisory Board
  - Research Team



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**For More Information Contact:**

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**[jmessner@engr.psu.edu](mailto:jmessner@engr.psu.edu)**

